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PATENT
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NITROGEN CAP CHUTE END

BACKGROUND OF THE INVENTION

- 5 **[001]** The present invention generally relates to apparatus and methods for capping containers and, more specifically, to apparatus and methods of ambient atmosphere capping of high speed, in-line containers having contents that can spoil in the presence of air.
- 10 **[002]** In many applications, containers hold contents that are susceptible to spoilage when exposed to air that may become entrapped in the containers when sealed or capped. These contents may, for example, be foodstuffs such as salad dressings. Specifically, air may be entrapped in the headspace between the upper level of the contents and the container opening. This problem exists for both rotating table machines and straight or in-line capping
- 15 machines. Rotating machines are generally characterized by having rotating tables that convey containers from one table to another, with each table carrying out a specified function. In-line machines, on the other hand, are generally characterized by having a horizontal moving conveyor which carries filled containers at about 250 containers per minute successively past a cap
- 20 feeding device, a cap applicator device, and a cap sealing device.
- 25 **[003]** In an effort to address the above problem of entrapped air, early filling and sealing/capping processes have been carried out in a vacuum chamber. Since then, sealing and capping methods have been designed to inject an inert gas into the filled or unfilled containers. This is intended to expel air before the container is sealed or capped. In some methods, a vacuum environment has still been needed for evacuating the containers before the

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inert gas is injected. In at least one method, the container must be evacuated simultaneously with injecting an inert gas. Also, the process of injecting the inert gas has been designed to occur in an inert gas chamber or other inert type of environment.

5 **[004]** Like the many methods of capping, the number of different apparatus employed to inject the inert gas and cap the container has been many. In one design shown in U.S. Patent no. 4,703,609, a nozzle is provided with a plurality of apertures to inject a liquefied gas into a single container to reduce vaporization of the gas and to reduce the amount of liquefied gas falling
10 into spaces between moving containers. Although the containers are to be immediately sealed, the apparatus for doing so is unclearly described.

[005] A gassing rail is disclosed in U. S. Patent no. 4,827,696 for injecting an inert gas through a plurality of bores and into the headspace of in-line containers. The gassing rail is described as being mounted to the underside of
15 a chute that seats end units or caps onto passing containers. Nevertheless, it is unclear how the gassing rail works in conjunction with the chute, if at all.

[006] Similarly, U.S. Patent no. 5,916,110 provides a gas-purging rail adjacent to a separate lid placement system. The gas-purging rail extends above the in-line moving containers and includes a plenum having openings to
20 allow an inert gas to flow into the containers. At a line speed of 400 containers per minute, the plenum is approximately 12 feet long. Again, however, it is unclear how the gas-purging rail operates in conjunction with the lid placement system.

[007] Unfortunately, the past methods and apparatus for capping
25 containers in the absence of air in the headspace have disadvantages. The need for expensive vacuum and/or inert gas chambers has made the sealing or capping process expensive. It has also made it slow due to the requirement of moving containers in and out of either a vacuum or inert gas chamber. In fact, even greater time is required when the containers must be stopped to inject an

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inert gas, conveyed, and then stopped again for applying a cap. Likewise, the apparatus employed has not provided integrated inert gas injection and capping to prevent ambient air from re-entering the containers in an ambient atmosphere. Rather, a non-integrated or discontinuous gas injection and capping has been provided. Also, past apparatus has not provided for increased line speed to consequently reduce manufacturing time and expense.

[008] As can be seen, there is a need for an improved apparatus and method that integrally removes air from the headspace and places caps on in-line moving containers, can be adapted to various sized headspaces, is effective in ambient atmosphere, and allows high in-line speeds of at least about 275 containers per minute.

SUMMARY OF THE INVENTION

[009] In one aspect of the present invention, a cap chute end subassembly for capping a plurality of in-line containers in an ambient atmosphere comprises a fluid manifold having a plurality of first manifold apertures for injecting a first fluid into the plurality of containers; a fluid shoe operatively adjacent the fluid manifold; the fluid shoe having a plurality of shoe apertures for dispensing a second fluid into the plurality of caps and plurality of containers; a frame that supports the fluid shoe; the frame being configured to receive a plurality of caps at a receiving end of the frame; a wiper supported at a dispensing end of the frame; a pair of arms operatively adjacent the fluid shoe; and the pair of arms being configured to orient the plurality of caps to the plurality of containers.

[0010] In another aspect of the present invention, a method of capping a plurality of in-line containers in an ambient atmosphere comprises injecting a first fluid into the plurality of containers; injecting a second fluid into the plurality of containers after injecting the first fluid; orienting a plurality of caps to the

plurality of containers; injecting the second fluid into the plurality of caps after orienting the plurality of caps; and placing the plurality of caps onto the plurality of containers after injecting the second fluid into the plurality of caps.

[0011] These and other features, aspects and advantages of the present invention will become better understood with reference to the following drawings, description and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

- 10 [0012] Figure 1a is a partial perspective top view of a capping assembly according to an embodiment of the present invention;
- [0013] Figure 1b is an exploded perspective view of a chute end subassembly of the capping assembly shown in Figure 1a;
- [0014] Figure 2 is perspective bottom view of the capping assembly shown
- 15 in Figure 1;
- [0015] Figure 3 is a top plan view of the capping assembly shown in Figure 1;
- [0016] Figure 4a partial perspective bottom view of a chute end subassembly that can be employed in the capping assembly of the present
- 20 invention, with a container approaching a cap to be placed on the container;
- [0017] Figure 4b is a partial perspective bottom view of the chute end subassembly of Figure 4b, with the container at the cap to be placed on the container;
- [0018] Figure 5a is a perspective view of a fluid manifold that can be
- 25 employed in the chute end subassembly of the present invention;
- [0019] Figure 5b is a schematic side view of the fluid manifold in Figure 5a and a fluid shoe of the chute end subassembly according to an embodiment of the present invention;

[0020] Figure 6 is a partial bottom perspective view of the chute end subassembly having a base portion of a fluid shoe that can be employed in the chute end subassembly of the present invention;

5 [0021] Figure 7 is a partial perspective view of the base portion shown in Figure 6;

[0022] Figure 8a is a partial perspective view of one embodiment of a cover portion of the fluid shoe shown in Figure 6;

[0023] Figure 8b is a partial perspective view of a second embodiment of a cover portion of the fluid shoe shown in Figure 6;

10 [0024] Figure 8c is a partial perspective view of a third embodiment of a cover portion of the fluid shoe shown in Figure 6;

[0025] Figure 8d is a partial perspective view of a fourth embodiment of a cover portion of the fluid shoe shown in Figure 6;

15 [0026] Figure 8e is a partial perspective view of a fifth embodiment of a cover portion of the fluid shoe shown in Figure 6;

[0027] Figures 9a-9f are schematic side views of various embodiments of a nozzle that can be employed in a fluid manifold and/or fluid shoe of the chute end subassembly of the present invention.

20 DETAILED DESCRIPTION OF THE INVENTION

[0028] An improved apparatus and method is provided by the present invention that integrally removes air from the headspace of and places caps on in-line moving containers. In doing so, air that may otherwise become
25 entrapped in the containers when sealed or capped is prevented. So prevented, spoilage to container contents, for example, foodstuffs such as salad dressings, is minimized. The present invention can be adapted to various sized headspaces, container configurations, and cap sizes. Importantly, the

present invention is effective in an ambient atmosphere, and allows high in-line speeds of at least about 275 containers per minute.

5 [0029] The present invention generally provides a capping assembly that may include a chute end subassembly that can integrally provide a continuous injection of a non-oxygen bearing (i.e., less than about 8-12% oxygen) fluid (e.g., liquid or gas), such as an inert fluid or gas like nitrogen and hydrogen into the headspace of in-line moving containers, as well as orienting and then placing the caps on the moving containers. Thereby, the flow of non-oxygen bearing fluid from the chute end subassembly is continuously injected into the
10 containers until the caps are placed on the containers for subsequent tightening. This is unlike the prior art of discontinuous or non-integrated gas injection and capping. The chute end subassembly of the present invention may also inject a non-oxygen bearing fluid not only directly into the containers but also indirectly into the containers. This indirect injection may be achieved
15 by injecting the fluid into the caps, and then deflecting the fluid from the caps and into the containers.

[0030] In referring to Figures 1-3, a capping assembly 10 of the present invention is shown. The capping assembly 10 may be part of a well-known in-line capping assembly such as that provided in U.S. Patent no. 5,669,209 and
20 incorporated herein by reference. The capping assembly 10 may include a roller or disc subassembly 11 and a chute end subassembly 12. While the roller subassembly 11 is shown for purposes of illustration with only one pair of opposed rollers, the present invention contemplates that a plurality of pairs of opposed rollers may be employed in a fashion similar to that described in U.S.
25 Patent 5,669,209. As such, the chute end subassembly 12 may, in part, provide a supply of caps that are placed on openings of in-line moving containers, such as about 275 to 600 containers per minute, while the downstream roller subassembly 11 tightens the caps onto the moving containers.

[0031] In Figures 1-3, a plurality of containers 13a-13c is depicted as moving in-line such as from a conveyor belt (not shown). For illustration, a first cap 14a has been placed on the opening of the first container 13a and is ready to be at least partially tightened by the roller subassembly 11 (Figures 1 and 3).

5 A second cap 14b is shown at a dispensing end of the chute end subassembly 12 for placement on the second container 13b (Figure 2). A third cap 14c is loaded in the chute end subassembly 12 upstream of the second cap 14b (Figure 3) for placement on the third container 13c. The third container 13c is upstream of and following the second container 13b towards the dispensing end of the chute end subassembly 12.

10 [0032] As better seen in Figure 4a, the third container 13c may be receiving through its opening at least one non-oxygen bearing fluid stream 29 at a first fluid station, as described below. Concurrently, the second container 13b may be at the dispensing end of the chute end subassembly 12 and nearing the second cap 14b. The second container 13b may then be receiving through its opening at least one non-oxygen bearing fluid stream 26 at a second fluid station, as further described below. In Figure 4b, the second container 13b has moved further down the capping line and is adjacent to the second cap 14b. At such point, the second container may still be receiving at least one non-oxygen bearing fluid stream 26. However, it may also be receiving at least one non-oxygen bearing fluid stream 31 at a third fluid station, and which stream 31 is being directed into the cap 14b and deflected into the second container 13b as will be described below in greater detail. Accordingly, it can be seen that the present invention can provide a "continuous injection" of at least one non-oxygen bearing fluid stream into each container until a cap is placed on the container. In other words, at any given time, each container is receiving at least one fluid stream, whether in the form of the fluid stream 26, 29, or 31 at one of a plurality of fluid injection stations.

[0033] The continuous injection of at least one non-oxygen bearing fluid stream into each container is provided by the chute end subassembly 12 that can include a fluid manifold 15. Although the manifold 15 may be of various configurations, it generally extends longitudinally along and parallel to the path of the in-line moving containers 13a-13c. The fluid manifold 15 may receive a first fluid via a fluid inlet 24 disposed, in this embodiment, at an end of the manifold 15 opposite the dispensing end of the chute end subassembly 12. The first fluid into the manifold 15 may be in the form of a non-oxygen bearing fluid.

[0034] As better seen in Figures 2 and 5a, the manifold 15 may provide a plurality of first manifold apertures or nozzles 16 at a first fluid injection station. The first apertures 16 may or may not be equally spaced apart, and may or may not be of the same configuration and dimension as further described below. A plurality of second manifold apertures 32 may be provided at the end of the manifold 15 opposite the fluid inlet 24. The second manifold apertures 32 may receive the first fluid from the fluid inlet 24 via a manifold channel 15a that extends along the longitudinal length of the manifold (Figure 5a). The second manifold apertures 32 may then provide fluid communication between the manifold 15 and a fluid shoe 23 of the chute end subassembly 12, as described in detail below. The first apertures 16 may receive the first fluid from the inlet 24 via the manifold channel 15a to provide a continuous injection of the first fluid in the form of a plurality of first fluid streams 29 into the moving containers 13a-13c.

[0035] What is meant by "continuous injection" into the containers vis-à-vis the manifold 15 is that, for each container 13a-13c, at least one first fluid stream 29 is always flowing into each container as each container passes along the manifold 15. As an example, in Figure 2, the third container 13c may receive the first fluid stream 29 out of the third from the left aperture 16 of the manifold 15. As the third container 13c moves to the right, when viewed from Figure 2,

the third container 13c may receive the first fluid stream 29 out of the fourth from the left aperture 16. However, there is no time during which the third container 13c does not receive the first fluid stream 29 from either the third or fourth from the left apertures 16.

5 **[0036]** The manner of providing continuous fluid injection from the manifold 15 is further depicted in Figure 5b. Therein, one or more of the first nozzles 16 from the manifold 15 may be oriented towards the horizontal plane of the container 13b opening at an angle " α ". The first nozzles 16 have a length "Y" while a distance "Q" separates the equally spaced apart nozzles 16. The
10 container 13b can be characterized by an opening diameter "x". A distance "h" separates the bottom of the nozzle 16 and the content level "L" in the container. In the event two nozzles 16 are desired to continuously inject fluid into a single container 13, then $Q < x$.

[0037] In this embodiment, the first fluid streams 29 may also be in a
15 "continuous flow" in that the first fluid streams 29 are always flowing out of the manifold 15, as opposed to first streams 29 only flowing out of the manifold 15 at intervals. Nevertheless, the present invention contemplates that the first fluid streams 29 may be provided non-continuously, or at intervals, such as when the total amount of the first fluid may be reduced for purposes of savings.
20 Further, the first fluid streams 29 may not be provided on "continuous injection" basis into the containers such as when containers are not present or when the container conveyor is stopped.

[0038] As better seen in Figure 1a, the chute end subassembly 12 may further include a longitudinally extending frame 17 having a pair of opposed
25 side sections 17c and bottom section therebetween (not shown). The frame 17 may further have a receiving end 17a and an opposed dispensing end 17b (Figures 1-3). At the receiving end 17a, the frame 17 is configured and dimensioned to receive the plurality of caps 14a-14c and enable the caps to move in-line due to gravity and towards the dispensing end 17b. The caps 14a-

14c may be guided through the frame 17 by a guide 18 that is opposite from the bottom section. The guide 18 may be a planar element that extends along the length of the frame 17 and that may interface the caps 14a-14c to keep the caps aligned. The guide 18 can be supported by a pair of guide mounts 20, with the guide mounts 20 being affixed to the frame 17. An adjusting bolt 21 can be associated with each mount 20 to adjust an amount of clearance between the guide 18 and the caps 14a-14c as the guide 18 interfaces the caps 14a-14c. Thereby, different sized height caps 14a-14c may be utilized with a single frame 17.

10 **[0039]** A pair of arms or jaws 22 may also be provided by the chute end subassembly 12 and located at the dispensing end 17b of the frame 17. One end of each arm 22 may be rotatably affixed at each side of the frame 17 and intermediate the receiving end 17a and the dispensing end 17b. The other or free end of each arm 22 may then be disposed immediately adjacent the dispensing end 17b. Thereby, the arms 22 may rotate about an axis such that the free ends of the arms 22 may come towards and away from one another. The amount of rotation or movement of the free ends of the arms 22 may be controlled by a tension spring 25 interposed between the arms 22.

15 **[0040]** Consequently, and due to their configuration and dimension, the free ends of the arms 22 can receive the caps 14 from the frame 17. Upon receiving the caps 14, the free ends of the arms 22 can hold the caps 14 in an orientation whereby the open sides of the caps 14 face the third fluid streams 31, as shown in Figure 4b. While the orientation may vary, the orientation may be described by an acute angle between a plane of the opening of the cap and a horizontal plane to the neck finish of the opening of the container and that is typically between about 0 to 90° (Figure 5b). In such orientation, a moving container can pull a cap 14 from the arms 22 as the container passes by the free ends of the arms 22. The amount of force necessary for a cap 14 to be

released from the arms 22 and placed onto the opening of a container 13 is controlled by the tension spring 25.

5 [0041] A wiper 19 can be disposed and supported at the dispensing end 17b of the frame to place a cap end 19a of the wiper 19 operatively adjacent the arms 22. The wiper 19 may be supported by the frame 17 by being affixed to the guide 18. A compression spring 28 can be provided proximate the end of the wiper 19 that is opposite the cap end 19a. The compression spring 28 may control the amount of compression at the cap end 19a, and which compression is placed on a cap 14. In operation, after a container 13 has pulled or picked
10 the cap 14 out the arms 22, the cap 14 may not be parallel to a plane of the opening of the container 13. If not parallel, the downstream roller subassembly 11 may not be able to tighten the cap 14 onto the container 13. To prevent such occurrences, the cap end 19a of the wiper 19 places and/or depresses the cap 14 onto the opening such that the cap 14 is oriented parallel to the plane of
15 the container 14 opening.

[0042] As mentioned above, and shown in Figure 6, the chute end subassembly 12 may also include a fluid shoe 23 that is supported by the frame 17 and is in fluid communication with the fluid manifold 15. In Figure 6, a base portion 23a of the fluid shoe 23 is adjacent the second manifold fold apertures
20 32 of the manifold 15. The base portion 23a can form a part of a shoe chamber 23c that may receive the first fluid via the second manifold apertures 32. From the shoe chamber 23c, the first fluid may exit through a shoe aperture or nozzle 27 that is also formed by a part of the base portion 23a.

[0043] Figure 7 depicts a cover portion 23b of the fluid shoe 23 that can
25 mate to the base portion 23a. The cover portion 23b may form the corresponding part of the shoe chamber 23c and the shoe aperture or nozzle 27.

[0044] In referring back to Figures 4a-4b, the shoe aperture 27 can dispense a second non-oxygen bearing fluid in the form of second fluid streams

31 into the caps 14. Upon entering the caps 14, the second fluid streams 31 may be deflected into the container 13. Because the shoe aperture 27 is in fluid communication with the shoe chamber 23c, the second fluid that comprises the second fluid streams 31 may be the same as the first fluid from the manifold 15. Alternatively, the second fluid may be different than the first fluid, and may be in the form of an inert fluid. Further, the shoe aperture 27 may have a curved configuration to match the curved configuration of the cap 14. With such curved aperture 27, the cap 14 may more readily pass out of the frame 17 and onto the container 13 opening.

10 **[0045]** In Figures 4a-4b, it can also be seen that the fluid shoe 23 can further provide a plurality of shoe apertures or nozzles 26. In turn, the apertures or nozzles 26 are in fluid communication with the shoe chamber 23c. Thereby, a third non-oxygen bearing fluid that comprises the third fluid streams 30 exiting from the apertures 26 may be the same as the first fluid from the manifold 15, as well as the second fluid. Nevertheless, the present invention contemplates that the third fluid may be different from the first and/or second fluids, may also be in the form of a non-oxygen bearing fluid, and be provided by a source other than the manifold 15. Additionally, even though the embodiment of Figures 4a-4b depicts three in-line nozzles 26 of the same dimension and equally spaced, the invention is not so limited.

20 **[0046]** For example, Figures 8a-8e show some alternative embodiments of the nozzles 26. In Figure 8a, four in-line nozzles 26 are depicted generally perpendicular to the wall 23d of the shoe chamber 23c. Figure 8b shows two rows of nozzles 26, with each nozzle angled to the chamber wall 23d at an angle other than about 90°. Figure 8c shows four in-line nozzles 26 at an acute angle to the chamber wall 23d. In Figure 8d, six in-line nozzles 26 are provided, with three nozzles 26 at an acute angle to the chamber wall 23d and three other nozzles 26 at an obtuse angle to the chamber wall 23d. In Figure 8e, two rows of nozzles 26 are generally perpendicular to the chamber wall

23d. Notwithstanding the foregoing examples, the present invention contemplates that other numbers, rows, and orientations of the nozzles 26 may be employed.

[0047] Furthermore, the configurations of the shoe nozzles 26 themselves
5 in the shoe 23 may vary and, consequently, the pattern of the stream exiting therefrom may vary and be in the form of a cylinder or cone, as an example. Similarly, the configurations of the manifold nozzles 16 may vary, as well as their numbers, rows, and orientations. Some exemplary configurations for the nozzles 16 and 26 are depicted in Figures 9a-9f. The nozzles may be of
10 configurations that are of a "cylindrical port" (Figure 9a), a "radiused port" (Figure 9b), a "port with two chamfers" (Figure 9c), a "cylindrical hole with chamfer on gas side" (Figure 9d), a "chamfered hole with larger radius on gas side" (Figure 9e), and a "chamfered hole with larger radius on non-gas side" (Figure 9f). Moreover, each of the nozzles 16 and 26 may be different from one
15 another in configuration, dimension, and angle to the openings of the containers.

[0048] Despite the above variations, there are useful characteristics of the nozzles 16 and 26. In referring to Figure 5b, when the distance "h" is between about 1 to 2 inches, then a length "Y" of the nozzle (16 or 26) throat may be
20 between about 0.25 to 0.50 inches. With a manifold 15 inlet diameter to a single nozzle 16 outlet diameter ratio between about 4.5 to 1.0, a pressure drop across the nozzle 16 may be from about 15 to 25 psi. A useful angle α may be from about greater than 0° to less than 180° . A distance "P" between the first nozzle 16 and the last nozzle 26 may be from about 4 to 18 inches when the
25 line speed is about 50 to 600 containers per minute. Nevertheless, it should be understood that the present invention envisions dimensions other than the foregoing to adapt to different operating environments, such as line speed and container configuration.

5 [0049] As can be appreciated by those skilled in the art, the present invention provides an improved apparatus and method of integrally removing air from the headspace of in line containers and capping the containers. By such integration, the present invention can provide continuous injection of an inert gas into the containers to expel the unwanted air up to the point where the caps are placed on the containers. Thus, the need for a vacuum or inert environment is eliminated. Further, by the integration of the inert gas injection and capping, in-line containers can be processed at speeds of at least 275 containers per minute and up to about 600 containers per minute. Higher (and even lower) in-line speeds may be achieved depending upon the configuration of the containers.

10 [0050] It should be understood, of course, that the foregoing relates to preferred embodiments of the invention and that modifications may be made without departing from the spirit and scope of the invention as set forth in the following claims.

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